



Procedures to analyse gamma-ray spectra obtained from the ORTEC or nuclear data ND-680 system by ORTEC's analysis software packages incorporated into a separate IBM-PC computer

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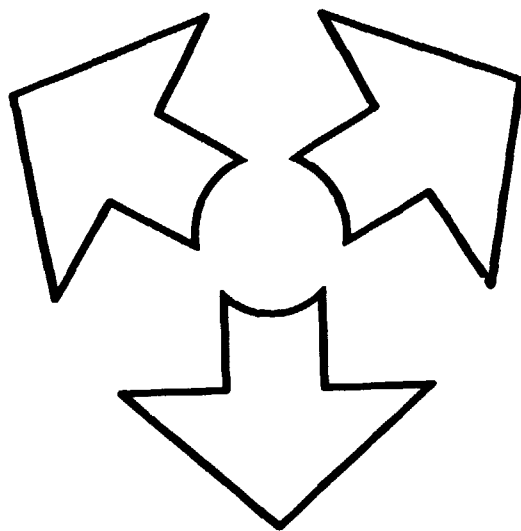
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**Procedures to Analyse γ -ray Spectra
Obtained from the ORTEC or
Nuclear Data ND-680 System by
ORTEC's Analysis Software
Packages Incorporated into a
Separate IBM-PC Computer**

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January 1990**

Procedures to Analyse γ -ray Spectra Obtained from the ORTEC or Nuclear Data ND-680 System by ORTEC's Analysis Software Packages Incorporated into a Separate IBM-PC Computer

Risø-M-2897

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January 1990*

Abstract. A detailed description is presented for processing γ -spectra produced by means of Ortec or Nuclear Data spectrometry systems on an off-line IBM-PC. The ORTEC analysis software packages were transferred to and implemented on the PC A/T, and the different spectra were recorded on discs and subsequently brought into the format required by the program for the calculation of photo peak areas.

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Section 1

Introduction

The net area (net counts) of the detected photo peaks in a γ -spectrum is an essential quantity in gamma-ray spectrometry. The numerical value of the net peak area for a detected photo peak, however, depends on the data evaluation strategy adopted by the computer program analyzing the obtained γ -ray spectrum. For a photo peak disturbed by strong background or/and by neighbouring strong photo peaks, or in multiplet with other peaks, the value of the net peak area will vary significantly when determined by different programs. There is no way to affirm which program yields the most reliable results for the net peak area values for all γ -spectra obtained in practice. An approach to solve this problem is to analyze a γ -spectrum by different programs; this provides at least some information about the reliability of the net peak area calculation by comparison of the results.

In the Isotope laboratory there are three programs available for γ -spectrum analysis: ORTEC's analysis software packages integrated in the ORTEC γ -ray spectrometer system; Nuclear Data program PEAK in the ND-680 system and a home-developed program PEAKB in a IBM-PC computer. It is of course desirable to make it possible applying all three programs to analyze γ -spectra obtained from the existing γ -spectrometer systems.

This work reports two procedures for applying the ORTEC analysis software packages stored in a separate IBM-PC computer to process

1. the γ -spectra obtained from ORTEC instruments but recorded on a disc as the transfer medium,
2. the γ -spectra obtained from the Nuclear Data ND-680 system but recorded on a disc as the transfer medium.

Section 2

Preparing to use the IBM-PC

- 2.1. Make sure the ORTEC's software packages have been incorporated into the separate computer.

```

C:\>
DIR
DIR
MCA
LIB
ULI
IP
BASIC
INA

```

- 2.2. Make the subdirectory INAAND for analyzing the γ -ray spectra obtained from the Nuclear Data ND-680 system

```

C:\> MD INAAND
C:\INAAND>

```

Section 3

Analysis of the γ -ray spectra from an ORTEC instrument by the ORTEC software packages stored in the separate IBM-PC

- 3.1. As a demonstration, an ORTEC γ -ray spectrum, 89080402.spc, obtained from the ORTEC instrument and recorded on a disc was processed using the IBM 100/150 MCA emulation software.

- 3.1.1. Copy the ORTEC γ -spectrum data file on the PC's hard disc.

Insert data disc into driver A:, then

* Grey colour : prompt by computer system
** Black colour : enter by user

```
C:\> COPY *.spc INAA\89080402
```

3.1.2. Convert .spc file to .CHN file

```
A:\> AIS spc to CHN
```

```
Enter input filename: INAA 89080402.spc
```

```
Enter output filename: INAA 89080402.CHN
```

3.1.3. Call MCA emulations software

```
A:\> CD MCA
```

```
MCA> MCA
```

The main menu of the system response will be shown on the computer screen window.

3.1.4. Load input file into MCA (current buffer of the PC)

Type **ALT 9** (9-Recall)

The user will be prompted the filename:

```
Enter input filename [.CHN]
```

```
INAA 89080402.CHN
```

Spectral graphics and textual information will be displayed as shown in Fig. 1 of the MCA manual.

3.1.5. Set Region-Of-Interest and perform calibration

· Type key **ALT 6** (6-calculation)

Calculation menu is shown on the screen as Fig. 6

· press **F2** Softkey, select ROI (Refer to page 30, MCA manual)

· Type key **ALT 1** (1-calibration)

The system prompts as followed:

```
Peak located in channel 827.26  
Enter energy in keV (0000.00)
```

```
Channel 827.26
```

```
Energy (keV) 320.0
```

```
First peak entered, find next peak
```

· Type **ALT/2** Select second peak

Type **ALT/1**

Enter next peak channel and energy in keV

Next peak located in channel XXXX.XX
Enter energy in keV (#####)

Channel 2449

Energy (keV) 33.4

3.1.6. Print out results of calculations

Type **ALL**

Hardcopy output can be obtained that shows statistical data related to regions-of-interest in the selected MCB segment. Hardcopy output of the analysis of 89080402.spc is shown in Appendix 1

3.2. Spectrum data analysis using ORTEC Applications Manager Software Module, MCA 100/150 GELIGAM Software Module and Master Library.

3.2.1. Create a library of nuclides with gamma-ray energies, half-lives and branching ratios.

The existing library INAALIB.LIB, INAALONG.LIB in subdirectory INAA can be used. Otherwise it is necessary to build a library (Refer to ORTEC manual, GELIGAM Example of Operations (A30-B1), page 2, ULI part).

3.2.2. Build Sample file, Detector file, Analysis parameter file and Calibration file.

These files were already combined in the ORTEC γ -spectrum data file, 89080402.spc. They are 001001.SMP, 001001.DET, 001001.PRM, 001001.CLB. So it is not necessary to create these files when dealing with the γ -spectrum obtained from the ORTEC instrument. Otherwise these files should be created (Refer to ORTEC manual, Applications Manager (A18-B1) Example of Operations, and GELIGAM Example of Operations (A30-B1).)

3.2.3. Create intermediate disc file (.UFO)

C> CD INAA

GERPAR > ASIAN

ANALYSIS PROGRAM FACT

COPYRIGHT 1987 EG&G ORTEC

VERSION 2.08

Enter the spectrum Name: (END): **12345678**

Enter the UFO Name: (UFO): **12345678**

Interactive parameter entry (NO) **N**

VERSION NUMBER MENU

- 0 GERPAR VALUE
- 1 GAMMA-1
- 2 GAMMA-2
- 3 GAMMA-3
- 4 NAA-1
- 5 RESERVED
- 6 NAA-3
- 7 LLD

Enter version number (**0**):

INTERACTIVE PARAMETER SECTION --

Enter mnemonic (END): **ALL**

Units (**MICROCURIES**):

Factor numerator (**1000**):

Factor denominator (**1000**):

File library Name: (NAALIB.LIB): **INAA10NG.LIB**

Gamma/RY (**10.00**):

Isotopic correction (NO) **N**

Decay correction (NO) **N**

Turn MDA on (NO) **N**

Externalize pointers (NO) ☐ Y
 Partial background correction (NO) ☐ Y
 Library correction (NO) ☐ Y
 Verify Percent, or Total uncertainty (P)
 L or Sigma (L) ☐ S
 Random summing (NO) ☐ Y
 No channel () ☐ 200
 No channel () ☐ 100
 Library correction (NO) ☐ Y
 No point low (NO) ☐ Y
 Every correct during acquisition (NO) ☐ Y
 Minimum unused peaks () ☐ 100
 Sigma percent per area reproducibility () ☐ 1000
 Sigma percent geometry reproducibility () ☐ 1000
 Enter library calibration filename (NONE): ☐ END OF P

3.2.4. Read the .UFO file and perform the analysis. Results of the analysis are transferred to the .UFO file.

CAVNA> ARG ANE

ANALYSIS PROGRAM PART 2

COPYRIGHT 1986 EG&G ORTEC

VERSION 2.08

Enter the UFO filename (UFO.UFO): ☐ 3230402.UFO

Do you another spectrum (NO) ☐ Y

3.2.5. Generate a report file. The analysis results are formatted according to the type of analysis performed.

C:\NAA> [REDACTED]

REPORT PROGRAM

COPYRIGHT 1986 EG&G ORTEC

VERSION 1.0

Enter input file name (CONCEPT): [REDACTED]

Enter input file name (UFO.UFO): [REDACTED]

[REDACTED]

3.2.6. Print the output of the analysis results

[REDACTED]

The output file is given in Appendix 2
(Analysis results of the γ -ray spectrum data, 89080402.spc)

Section 4

Analysis of the γ -ray spectrum from Nuclear Data ND-680 System by the ORTEC software packages available in the separate IBM-PC

As a demonstration, a ND γ -ray spectrum, 179037.S00, obtained from the ND-680 system and recorded on a disc, was analyzed.

4.1. Enter input file and change the format of the input-file

[REDACTED]

4.1.1. **[REDACTED]** **[REDACTED]**

[REDACTED]

4.1.2. Load **[REDACTED]** program Execute **[REDACTED]**, then NDOUT1.DAT is created.

4.1.3. Load **[REDACTED]** program Execute **[REDACTED]**, then NDOUT2.DAT is created.

EMP> DENMARK

STANDARD> ASCII FILE CONVERSION

4.1.4. Execute program ASCBIN-BAS

STANDARD> ASCII

ASCBIN

A SOFTWARE PRODUCT FROM

CAC DENMARK

END

ASCBIN CONVERTS AN ORTEC SPECTRUM FILE

TO AN ASC FILE OR VICE VERSA

The system prompts with as shown above and ask user to select «options»

OPTIONS

ORTEC FILE TO ASC FILE (CHN TO DAT)

ASC FILE TO ORTEC FILE (DAT TO CHN)

QUIT

EXIT

ENTER OPTION:

HAVE YOUR SPECTRA BEEN CREATED BY ASCBIN OPTION 1 (Y/N):

NUMBER OF CHANNELS PER SPECTRUM (MAX 8192):

NUMBER OF CHANNELS PER RECORD:

NUMBER OF SPECTRA TO BE CONVERTED (MAX 50):

SPECTRUM NO. 1 INPUT FILENAME:

OUTPUT FILENAME:

ARE THE FILE NAMES CORRECT (Y/N):

Now the .CHN file was created, but the format of this file is different from that required. So the program ASCBIN will be executed again but with the first option selection:

```

C:\INAAND> ASCBIN

WHICH OPTION? 1

HAVE YOUR SPECTRA BEEN CREATED BY ASCBIN OPTION 1 (Y/N): Y

NUMBER OF CHANNELS PER SPECTRUM (MAX 8192) 8192

NUMBER OF SPECTRA TO BE CONVERTED (MAX 10) 1

SPECTRUM NO. 1 INPUT FILENAME 179037

OUTPUT FILENAME 179037.DAT

ARE THE FILENAMES CORRECT (Y/N) Y

```

In order to be analyzed by the ORTEC software packages, the program ASCBIN will be executed once more with the second option selected to convert the new formed .DAT file to .CHN file:

```

C:\INAAND> ASCBIN

WHICH OPTION? 2

HAVE YOUR SPECTRA BEEN CREATED BY ASCBIN OPTION 1 (Y/N): Y

NUMBER OF CHANNELS PER SPECTRUM (MAX 8192) 8192

NUMBER OF SPECTRA TO BE CONVERTED (MAX 10) 1

SPECTRUM NO. 1 INPUT FILENAME 179037

OUTPUT FILENAME 179037.CHN

ARE THE FILENAMES CORRECT (Y/N) Y

```

Finally, the required .CHN file, i.e. 179037.CHN, was obtained. The printout of the 179037.CHN was presented in Appendix 3.

4.2. Data analysis using the IBM 100/150 MCA Emulation Software.

Following the procedures presented in 3.1.3 to 3.1.6. The analysis results, given in Appendix 4, were obtained.

4.3. Analysis of the γ -ray spectra from Nuclear Data ND-680 system using ORTEC Software Application Manager Software Module, MCA 100/150 GELIGAM Software Module and MCA 100/150 Master Library.

4.3.1. Create a sample description file

```
C:\INAAND> \A18\Sample
```

```
Enter MCA number ( 0): 1
```

```
Enter segment number ( 1): 1
```

```
Enter sample description (2 x 64 characters)
```

```
1> (NONE): AN UNKNOWN SAMPLE FROM DR. K. HEYDORN
```

```
2> (NONE):
```

```
Any changes (NO)?
```

Now, the sample description file 001001.SMP was created in \INAAND subdirectory.

4.3.2. Create a Detector description file

```
C:\INAAND> \A18\Detector
```

```
Enter MCA number ( 0): 1
```

```
Enter segment number ( 1): 1
```

```
Enter detector number ( 0): 0
```

```
Enter detector description (2 x 60 char.)
```

```
1> Detector: GAMMA-X/S 72
```

```
2> DATA FROM ND
```

```
Any changes (NO)?
```

Detector description file 001001.DET was created in \INAAND subdirectory.

4.3.3. Create a GERPAR file

GERPAR program can be used to create or modify an analysis parameter file

```
C:\INAAND> \A18\GERPAR
```

Enter MCA number (): 1

Enter segment number (): 1

Modify this file (N): Y

VERSION NUMBER MENU

0	GERPAR VALUE
1	GAMMA-1
2	GAMMA-2
3	GAMMA-3
4	NAA-1
5	RESERVED
6	NAA-3
7	LLD

Enter version number (): 2

---INTERACTIVE PARAMETER SECTION---

Enter harmonic (END): ALL

Units (MICROCURIES):

Factor numerator (1.000):

Factor denominator (1.000):

First library filename (.LIB): INAALIB.LIB

Sensitivity (20.00):

Scorpion correction (NO)?

Decay correction (NO)?

Turn MDA off (NO)?

Intermediate printout (NO)? Y

Peaked background correction (NO)?

Recovery correction (NO)?

Activity, Percent, or Total uncertainty (P):

1, 2, or 3 sigma (2):

True coincidence correction (NO):

Random summing (NO)?

Enter starting channel (50): 300

Enter ending channel (8000): 8100

Geometry correction (NO)

Five point low (NO)

Decay correct during acquisition (NO)

Enter mnemonic to change (END):

4.3.4. Create a preliminary .spc file

C:\INAAND> Convert

SPECTRUM CONVERSION ROUTINE

COPYRIGHT 1985 EG & G ORTEC

VERSION 2.08

Enter input filename (END): 179037.CHN

FILE NOT FOUND 001001.SOR

FILE NOT FOUND 001001.GEO

FILE NOT FOUND 001GJL.QAF

FILE NOT FOUND 001001.ROI

FILE NOT FOUND 001001.SEQ

CONVERSION MADE

4.3.5. Create a new calibration file

C:\INAAND> \A 30\CLB

CALIBRATION PROGRAM

COPYRIGHT 1984 EG & G ORTEC

Turn on the tracing (NO)

Enter calibration output filename (END): 001001.CLB

File already exists; do you want to replace it (NO)? Y

Enter calibration description

> This is another calibration

>

Any changes (NO)?

Do you want to do a new energy-shape calibration? Y

Enter the spectrum filename (NONE): 179037.spc

179037.spc

ACQUIRED ON 01-JAN-86 AT 12:00:00

AN UNKNOWN SAMPLE FROM DR. K. HEYDORN

Is this the right file (NO)? Y

Start channel (50): 300

Stop channel (7950):

Five point low (NO)?:

CHANNEL NUMBER AND ENERGY (keV) PAIRS

Enter channel number (299): 787.9

Enter corresponding energy (keV) (1.000): 312.7

Enter channel number (299): 1256.0

Enter corresponding energy (keV) (1.000): 502.7

Enter channel number (299): 2518.0

Enter corresponding energy (keV) (1.000): 1013.7

Enter channel number (299):

Any changes (NO)?

Do you want to do a new efficiency calibration (NO):

Enter old calibration filename with efficiency calibration

(NONE): \INAA\001001.CLB

001001.CLS

CREATED ON 17-APR-89 AT 09:51:2

DESCRIPTION (NONE)

*** END OF CALIBRATION ***

6. Create an expected .spc file.

C:\NAAND> \A18\Convert

SPECTRUM CONVERSION ROUTINE

COPYRIGHT 1985 EG&G ORTEC

VERSION 2.00

Enter input file name (END): 179037.CHN

FILE NOT FOUND 001001.SOR

FILE NOT FOUND 001001.GEO

FILE NOT FOUND 001001.QAF

FILE NOT FOUND 001001.ROI

FILE NOT FOUND SEQNUM.SEQ

CONVERSION MADE

Now the required 179037.spc file was created; this can be analyzed by the ORTEC software, in the same way as the γ -ray spectrum data obtained directly from the ORTEC instrument.

7. Executing program AN1

C:\NAAND> \A30\AN1

ANALYSIS PROGRAM PART 1

COPYRIGHT 1986 EG&G ORTEC

VERSION 2.00

Enter the Spectrum Name (END): **PC37SPC**

Enter the UFO Name (UFO): **PC37UFO**

Interactive parameter entry (NO)? **Y**

VERSION NUMBER MENU

0 GERPAR VALUE
1 GAMMA-1
2 GAMMA-2
3 GAMMA-3
4 NAA-1
5 RESERVED
6 NAA-2
7 LLD

Enter version number (0-7): **0**

INTERACTIVE PARAMETER SECTION --

Enter spectrum (END): **All**

Units: **MICROCURIES**

Enter numerator (1-999): **100**

Enter denominator (1-999): **100**

Peak library file name (INAALIB.LIB): **INAALONG.LIB**

Efficiency (0.00-1.00): **0.5**

Random correction (NO) **P**

Decay correction (NO) **R**

Turn MDA off (NO) **P**

Intermediate printout (NO) **NY**

Printed background correction (NO) **P**

Geometry correction (NO) **P**

Only, Percent, or Total uncertainty (P)

Print Spectrum (NO) **P**

Random printing (NO) **P**

Print Channel (0-200)

Print Channel (0-200)

Geometry correction (NO)?

File path for (NO)?

Decay correct during acquisition (NO)?

Minimum summed peaks ()?

Input percent net area reproducibility ()?

Input percent geometry reproducibility ()?

Enter alternate calibration filename (NONE): 001001 CLB

8. Executing program AN2

E:\NAA> A30 AN2

ANALYSIS PROGRAM PART 2

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VERSION 2.06

Enter the UFO filename (UFO.UFO): 179037.UFO

Analyze another spectrum (NO)?

9. Executing program RPT

E:\NAA> A30 RPT

REPORT PROGRAM

COPYRIGHT 1986 EG&G ORTEC

VERSION 2.06

Enter the output report filename (CON.RPT): 179037 RPT

Enter the UFO Slewage (UFO.UFO): 179037 UFO

Print more reports (NO.....)?

10. Print out the analysis results.

SYNAA> PRINT 179037 RPT

The output is given in Appendix.

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 - Software Loading Instructions for IBM-PC
 - A18-B1 Applications Manager
 - Application Manager (A18-B2) Examples of Operation
 -
 - Basic Gamma-Ray Spectroscopy
 - A30-B1 GELIGAM Germanium Analysis Software
 - Geligam (A30-B1) Examples of Operation
 - Model A53 Master Library for Master Library Members.

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